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EXAMINER

GUGLIOTTA, NICOLE T

ART UNIT

PAPER NUMBER

1794

NOTIFICATION DATE

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ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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DETAILED ACTION

Examiner's Note

Examiner acknowledges the amendments to claims 1 & 6, as well as the cancellation of claim 2.

Claim Objections

1. Claims 12 – 16 are objected to for an incorrect status identifier.

MPEP 714 [R-6] II. C. A. states the following:

For any amendment being filed in response to a restriction or election of species requirement and any subsequent amendment, any claims which are non-elected must have the status identifier (withdrawn).

Claims 12 – 16 are non-elected claims in response to a restriction requirement and are therefore withdrawn from examination, as stated in the previous office action. These claims should have the status identifier "(withdrawn)". Correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 6 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The most recently filed remarks by Applicant

direct the Examiner to the second full paragraph of pg 10 of the specification for support of this amendment. However, this particular passage of the specification refers to the orientation factor of the carbon nanotubes, not the orientation factor of the wholly aromatic polyamide. The first full paragraph on page 12 of Applicant's specification discloses the orientation factor should be 0.5 or more. The Examiner was unable to find written support for Applicant's limitation in claim 6 for an orientation factor F of the wholly aromatic polyamide in the range of 0.3 to less than 0.5.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 3 – 4 & 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harmer et al. (U.S. Patent No. 5,512,368), in view of Ebbesen et al. ("Large Scale Synthesis of Carbon Nanotubes", Nature, Vol. 358, page 220 (1992)).

In regard to claims 1 & 4, Herman et al. disclose fibers made from organic polymer (Col. 1, Lines 45 – 50) reinforced with inorganic whiskers, such as carbon nanotubes (Col. 2, Lines 55 - 57). The whiskers are particles having an average aspect ratio of about 5 or more, and an average diameter of about 0.1 to 1.5 μm (100 nm – 1500 nm) (Col. 2, Lines 43 - 54). A specific example of organic polymer used is poly(p-

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phenylene terephthalamide) (PPTA), which has the structure $(-\text{NH}-\text{Ar}_1-\text{NH}-\text{CO}-\text{Ar}_1-\text{CO}-)_n$, where Ar_1 is a phenyl ring. Herman et al. disclose 18.1 g of whiskers (26% by weight) and 51.9 g of PPTA (74% by weight) were added toward the fiber composition (Col. 3, Line 60 - Col. 4, Line 2).

Considering the orientation factor, F , of claims 1 and 6, MPEP 2112 [R-3] states:

The express, implicit, and inherent disclosures of a prior art reference may be relied upon in the rejection of claims under 35 U.S.C. 102 or 103. "The inherent teaching of a prior art reference, a question of fact, arises both in the context of anticipation and obviousness." *In re Napier*, 55 F.3d 610, 613, 34 USPQ2d 1782, 1784 (Fed. Cir. 1995) (affirmed a 35 U.S.C. 103 rejection based in part on inherent disclosure in one of the references). See also *In re Grasselli*, 713 F.2d 731, 739, 218 USPQ 769, 775 (Fed. Cir. 1983).

The orientation factor is a measure of particle/fiber alignment with the fiber.

Applicants teach "a feature of the invention resides in that the carbon nanotubes in the composite fiber are oriented in the fiber axis direction. The orientation property of such carbon nanotubes is evaluated by, other than the direct observation of the fiber cross section cut in parallel with the fiber axis with an electron microscope such as TEM, in the invention, an X-ray diffraction measurement or a polarized Raman spectroscopic measurement. When each carbon nanotube is a multiwall carbon nanotube, it is possible to use the orientation factor F " (specification, Pg 9). The orientation factor F of the multiwall carbon nanotube in the invention is preferably 0.1 or more...the theoretical upper limit value when the multiwall carbon nanotubes have been fully oriented is 1.0" (specification, Pg 10).

The nanotubes (whiskers) and some aramids (e.g. PPTA) disclosed by Herman et al. are aligned with the fiber axis. "This is usually advantageous, as this alignment further improves properties of the fiber measured along the long axis of the fiber, as is

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usually desired" (Col. 3, Lines 5 - 18). Both Applicants and Herman et al. disclose carbon nanotubes and polyamides aligned with the fiber axis. Therefore, it would be reasonable to believe the nanotubes & PPTA disclosed by Herman et al. have the same orientation factor as claimed by Applicant.

Harmer et al. is silent in regard to the type of carbon nanotubes used for their invention.

However, Harmer et al. direct their readers to the reference of Ebbesen et al. in regard to the carbon nanotubes used for their invention. Ebbesen et al. disclose their synthesized carbon nanotubes consist of two or more concentric shells of carbon sheets (multi-walled carbon nanotubes) (Page 221, Figure 3).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the multiwalled nanotubes disclosed by Ebbesen et al. into the invention disclosed by Harmer et al.

In regard to claim 3, the degree of orientation is the measure of alignment. Since the nanotubes disclosed by Herman et al. are aligned with the fiber axis, it would have the same degree of orientation as claimed by Applicant.

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Herman et al. and Ebbesen et al. as applied to claim 1 above, and further in view of Tamura et al. (U.S. Patent No. 4,539,393).

When claim 5 is considered, Harmer et al. disclose carbon nanotubes mixed with an aromatic polyamide, such as p-phenyleneterephthalamide, to form fibers. However, Harmer et al. are silent in regard to copolymerizing such a polyamide with a 3,4'-diaminodiphenyl ether unit.

Tamura et al. disclose the copolymerization of p-phenyleneterephthalamide with 50 mol% 3,4'-diaminodiphenyl ether units (Example 15, Col. 17, Line 65 – Col. 18, Line 28) for producing films for fiber, paper and the like (Col. 1, Line 20).

It would have been obvious to one of ordinary skill in the art at the time of the invention to copolymerize the p-phenyleneterephthalamide polymer in the fiber disclosed by Harmer et al. with 50 mol% 3,4'-diaminodiphenyl ether units, as disclosed in the fiber forming films of Tamura et al., in order to form dimensionally stable fibers with excellent mechanical, thermal, and electrical properties (Col. 1, Line 62 – Col. 2, Line 3).

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Herman et al. and Ebbesen et al. as applied to claim 1 above, and further in view of Margrave et al. (US 2002/0110513 A1).

When claim 7 is considered, Harmer et al. are silent in regard to the proportion of oxygen atoms and carbon atoms on the surface of the nanotube.

Margrave et al. disclose functionalizing the sidewalls of nanotubes with moieties that have chemical and steric properties to prevent the nanotubes from reassembling into bundles (¶ [0018]). Suggested moieties include functional groups containing

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oxygen, such as hydroxyl groups, and acyl groups (¶ [0065] – [0071], [0074]), attached to a carbon nanotube, due to nucleophilic substitution of fluorine. In a specific example of a nucleophilic substitution with methoxide, the product resulted in a C/F/O ratio of at least about 79/17/4 (¶ [0143]). It is assumed the oxygen ratios are reflective of the number of methoxy groups present on the side wall of the nanotube, and therefore there are 4 oxygen atoms for every 79 carbon atoms. This equates to approximately 5 oxygen atoms for every 100 carbon atoms.

Therefore, it would have been obvious to one of ordinary skill in the art to functionalize a carbon nanotube surface with groups comprising oxygen in a ratio of 5 oxygen atoms for every 100 carbon atoms, as these groups prevent the nanotubes from reassembling into a bundle, as disclosed by Margrave et al.

6. Claims 8 – 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Herman et al. and Ebbesen et al. as applied to claim 1 above, and further in view of Smalley et al. (WO98/39250).

When claim 8 is considered, Harmer et al. are silent in regard to physical size reduction treatment of the carbon nanotubes of their invention.

However, Smalley et al. disclose making a fibrous material comprising carbon nanotubes and applying a physical size reduction treatment, such as a sonication cutting treatment (Pg 26, Lines 23 - 25) and exposure to acid (Pg 27, Lines 20 - 25). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply a physical size reduction treatment to the carbon nanotubes disclosed by Harmer

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et al. because carbon nanotubes should be cut to a length to prevent tangling (Pg 25, Lines 1 – 5).

Considering claims 9 & 10, Harmer et al. are silent in regard to acid treatment and esterification of the carbon nanotubes of their invention. However, Smalley et al. disclose oxidation by strong acid treatment, resulting in esterification of the carbon nanotubes (Pg. 22, Line 13 – Pg. 23, Line 2).

It would have been obvious to one of ordinary skill in the art at the time of the invention to oxidize nanotubes in order to remove amorphous carbon deposits and other contaminating material (Pg 22, Lines 1 - 5), which would result in esterification of the carbon nanotubes, as taught by Smalley et al.

7. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Herman et al. and Ebbesen et al. as applied to claim 1 above, and further in view of Niu et al. (US 2003/0089893 A1).

Claim 11 defines the product by how the product was made (i.e. amidation of a carbon nanotube after treatment with a strong acid and esterification). Thus, claim 11 is a product-by-process claim. For purposes of examination, product-by-process claims are not limited to the manipulation of the recited steps, only the structure implied by the steps. See MPEP 2113. In the present case, the recited steps imply a structure having an amide functional group bonded to a carbon nanotube after oxidation. The references suggest such a product.

Examiner refers applicant to MPEP § 2113 [R - 1] regarding product-by-process claims. "The patentability of a product does not depend on its method or production. If the product in the product-by-process claim is the same as or obvious from a product or the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777, F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citation omitted)

Once the examiner provides a rationale tending to show that the claimed product appears to be same or similar to that of the prior art, although produced by a different process, the burden shifts to the applicant to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product. *In re Marosi*, 710 F.2d 798, 802, 218, USPQ 289, 292 (Fed. Cir. 1983)

When the limitations of claim 11 are considered, Harmer et al. is silent in regard to functionalizing the carbon nanotubes of their invention with an amide group.

However, Niu et al. disclose a carbon nanotube can be functionalized by converting the carboxylic acid group to an amide by a chemical reaction with amines (¶ [0100] – [0101]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to functionalize the carbon nanotubes of Harmer et al., such as by amidation, in order to improve the chemical bonding between the nanotubes and a substrate, such as a polyamide polymer (¶ [0022], [0088] – [0089]), as taught by Niu et al.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

8. Claims 1, 3 – 6 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 – 4 and 17 - 21 of copending Application No. 10/542,641. Although the conflicting claims are not identical, they are not patentably distinct from each other because both applications disclose carbon nanotubes combined with the same specific aromatic polyamides, in the same proportions. Therefore, it would have been obvious to one of ordinary skill in the art that the Application of 10/542,641 and the present application would result in a final product of the same composition.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

9. Applicant argues, "Applicants note that Harmer discloses inorganic whiskers (see Column 2, line 45~), especially inorganic whiskers made of SiC. Applicants submit that Harmer is silent about the dispersion or orientation of whiskers in the composite fibers Harmer is silent about multi-wall carbon nanotubes, and their dispersion and/or their orientation at composite fiber" (Remarks, Pg 6).

EXAMINER'S RESPONSE: Applicant's arguments with respect to the presence of multi-wall carbon nanotubes have been considered but are moot in view of the new ground(s) of rejection.

Regarding Applicant's argument that Harmer et al. do not disclose the orientation of the whiskers, the Examiner respectfully disagrees with Applicant's interpretation of the Harmer et al. reference. As discussed above, Harmer et al. disclose the carbon nanotubes are aligned (oriented in a parallel direction) with the fiber.

10. Applicant argues, "...Applicants refer the Examiner initially to the discussion set forth above with respect for Harmer. Further, Applicants submit that Ebbesen merely discloses the synthesis of the multi-wall carbon nanotubes. Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested" (Remarks, Pg 7).

EXAMINER'S RESPONSE: Applicant's arguments have been fully considered but they are not persuasive. Examiner interprets Applicant's argument to be that

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Ebbesen et al. fail to disclose the limitations Applicant sees as deficient in the reference of Harmer, in particular the orientation factor F of the carbon nanotubes. Examiner agrees that Ebbesen merely discloses the synthesis of multi-wall nanotubes and directs Applicant to the above discussion of Harmer et al. regarding the orientation factor.

11. Applicant argues, "...with respect to Veedu et al., Applicants submit herewith a verified English translation of the present priority application supporting the elements of the rejected claims (see claims 1 and 2 and paragraph [0026] in the verified translation) to antedate the June 30, 2003 U.S. filing date of the reference (for the purpose being relied upon by the Examiner, Veedu is not entitled to its July 1, 2002 provisional application filing date, since the disclosure being relied upon by the Examiner is not present in Veedu's provisional application). Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested" (Remarks, Pg 8).

EXAMINER'S RESPONSE: Applicant's arguments with respect to Veedu et al. have been fully considered and are persuasive. The rejection of claims 2 & 6 under Veedu et al. has been withdrawn.

12. Applicant argues, "...Applicants submit that Margrave merely discloses single wall carbon nanotubes. Thus, Applicants submit that the present invention is not taught or suggested by Margrave, and withdrawal of this rejection is respectfully requested" (Remarks, Pg 8).

EXAMINER'S RESPONSE: Applicant's arguments have been fully considered but they are not persuasive. Examiner interprets Applicant's argument to be that Margrave et al. fail to disclose the limitations Applicant sees as deficient in the reference of Harmer, in particular the orientation factor F of the carbon nanotubes. Examiner directs Applicant to the above discussion of Harmer et al. regarding the orientation factor. .

13. Applicant argues, "...Applicants submit that Smalley merely discloses single wall carbon nanotubes, so the present invention is different from Smalley as well" (Remarks, Pg 9).

EXAMINER'S RESPONSE: Applicant's arguments have been fully considered but they are not persuasive. Examiner interprets Applicant's argument to be that Smalley et al. fail to disclose the limitations Applicant sees as deficient in the reference of Harmer, in particular the orientation factor F of the carbon nanotubes. Examiner directs Applicant to the above discussion of Harmer et al. regarding the orientation factor.

14. Applicant argues, "...Applicants note initially that the present application was filed in the U.S. prior to the copending application. Further, as set forth in MPEP 8041.B.1., if a 'provisional' nonstatutory obviousness-type double patenting (ODP) rejection **is the only rejection remaining** in the earlier filed of the two pending applications, while the later-filed application is rejectable on other grounds, the examiner should withdraw that

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rejection and permit the earlier-filed application to issue as a patent without a terminal disclaimer. Since Applicants submit that all of the art rejections are overcome for the reasons discussed above, this provisional obviousness-type double patenting rejection should be withdrawn because it would be the only rejection remaining in the present application" (Remarks, Pg 10).

EXAMINER'S RESPONSE: Applicant's arguments have been fully considered but they are not persuasive. Examiner respectfully disagrees that all of the art rejections are overcome. Therefore, the ODP rejection is not the only rejection remaining. For this reason the Examiner maintains the ODP rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NICOLE T. GUGLIOTTA whose telephone number is (571)270-1552. The examiner can normally be reached on M - F 8:30 a.m. - 6 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David R. Sample can be reached on 571-272-1376. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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